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United States Patent [19]**Burcham, Jr. et al.**[11] **Patent Number:** **6,126,111**[45] **Date of Patent:** **Oct. 3, 2000**[54] **EMERGENCY FLIGHT CONTROL SYSTEM
USING ONE ENGINE AND FUEL TRANSFER**5,531,402 7/1996 Dahl 244/75
5,660,358 8/1997 Grafwallner et al. 244/135[75] Inventors: **Frank W. Burcham, Jr.**, Lancaster;
John J. Burken, Tehachapi; **Jeanette
Le**, Lancaster, all of Calif.**OTHER PUBLICATIONS**Transcript of Recording of Capt. Al Haynes Interview on
May 24, 1991 Provided by Nasa-Dryden.[73] Assignee: **The United States of America as
represented by the Administrator of
the National Aeronautics and Space
Administration**, Washington, D.C.*Primary Examiner*—Robert P. Swiatek
Attorney, Agent, or Firm—John H. Kusmiss[57] **ABSTRACT**

A system for emergency aircraft control uses at least one engine and lateral fuel transfer that allows a pilot to regain control over an aircraft under emergency conditions. Where aircraft propulsion is available only through engines on one side of the aircraft, lateral fuel transfer provides means by which the center of gravity of the aircraft can be moved over to the wing associated with the operating engine, thus inducing a moment that balances the moment from the remaining engine, allowing the pilot to regain control over the aircraft. By implementing the present invention in flight control programming associated with a flight control computer (FCC), control of the aircraft under emergency conditions can be linked to the yoke or autopilot knob of the aircraft. Additionally, the center of gravity of the aircraft can be shifted in order to effect maneuvers and turns by spacing such center of gravity either closer to or farther away from the propelling engine or engines. In an alternative embodiment, aircraft having a third engine associated with the tail section or otherwise are accommodated and implemented by the present invention by appropriately shifting the center of gravity of the aircraft. Alternatively, where a four-engine aircraft has suffered loss of engine control on one side of the plane, the lateral fuel transfer may deliver the center of gravity closer to the two remaining engines. Differential thrust between the two can then control the pitch and roll of the aircraft in conjunction with lateral fuel transfer.

[21] Appl. No.: **09/112,067**[22] Filed: **Jul. 8, 1998**[51] **Int. Cl.**⁷ **B64C 17/10**; B64C 15/02[52] **U.S. Cl.** **244/75 R**; 244/51; 244/135 C[58] **Field of Search** 244/75 R, 76 R,
244/78, 80, 220, 221, 226, 93, 135 R, 135 C,
51[56] **References Cited****U.S. PATENT DOCUMENTS**

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9 Claims, 1 Drawing Sheet